IMPLEMENTING FIXED WIRELESS ACCESS SERVICES WITH THE LMS2000 FOR THE SMALL AND MEDIUM-SIZED BUSINESS MARKETS

An Overview

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INTRODUCTION

Communications service providers face several challenges in the current marketplace as a result of fundamental changes in the regulatory environment, coupled with rapid technological advances and increasing customer demand. In order to succeed in this new environment, service operators need to: 1) increase new service innovation and velocity; 2) decrease the cost of doing business; and 3) improve relationships with customers.

The next wave of Internet access via broadband access technologies provides operators with the opportunity to meet these challenges. The demand for broadband service is accelerating, driven by requirements ranging from the need for faster Internet connections, to the growth of data transportation and the emergence of e-commerce. Network operators who are positioned to meet this demand for broadband services will enhance their role in the access market and ultimately the revenues they earn. WaveRider Communications has developed a fixed wireless access system, the LMS2000, which will enable network operators to exploit these opportunities in providing broadband communications services to the at the small and medium-sized business (SMB) market

There are a number of broadband access technology options available to network operators. These include cable modems, xDSL and optical fiber. Each of these technologies has its advantages, but they are not available in all markets and in some markets it is not economically feasible for network operators to deploy them. Wireless technology has emerged as a strong alternative in providing high-speed and high-quality access, particularly in markets where the wired broadband options are not available. Several network operators have discovered that wireless technology enables them to remain competitive by meeting the growing demand for broadband access from their business customers.

Market analysts predict that fixed wireless access is poised for explosive growth. In a study released in May 2000, the Strategis Group estimated that global service revenues from fixed wireless access are projected to reach $16.3 billion by 2004, a compound annual growth rate of 140 percent over 1999 revenues. According to Strategis, the opportunities for fixed wireless access services are worldwide. By 2004, the North American market will account for 39 percent ($6.4 billion) of total revenue. Forecasted service revenues in 2004 for Europe are $4.1 billion, Asia will account for $3.0 billion, and Latin America will total approximately $2.7 billion.

A more recent study by the ARC Group released in October 2000 is more optimistic. Its projects that worldwide revenue from broadband wireless will reach $42 billion by 2005. By 2005, Europe will account for approximately $11 billion, the US for $9 billion and the rest of the world $22 billion. The basic conclusion of this and other market studies is that where DSL and cable modem access had once been touted as the most efficient means of broadband access, the speed and cost-effectiveness of fixed wireless can place wireless operators in a prime position to gain market share.

Because of this huge market potential, both in the developed and in the developing world, network operators are looking at fixed wireless technology to enhance their service offerings and to take advantage of the opportunities presented by this technology. In addition to examining this technology, network operators are investigating the issues and benefits in becoming a **W**ireless **I**nternet **S**ervice **P**rovider or WISP. Becoming a WISP presents not only significant revenue and margin opportunities but allow network operators to target specific customer segments, thereby differentiating themselves from the competition.

In order to assist WISPs in the planning process, this paper examines the business and technical issues that a WISP needs to examine before implementing a fixed wireless access system such as the LMS2000 specifically targeted at the SMB market.

FIXED WIRELESS ACCESS SYSTEMS

Fixed wireless access (FWA) systems can be classed under licensed and license-free systems. The two principal licensed systems are Local Multipoint Distribution Systems (LMDS) and Multichannel Multipoint Distribution Systems (MMDS). LMDS operates in frequencies that range from 27-31 GHz. The principal advantage of LMDS is that with a total of 1,300 MHz available it contains more spectrum than any other commercial wireless service. Because LMDS systems operate at higher frequencies, the transmission distances are limited, consequently LMDS systems are deployed in dense urban markets in order to achieve sufficient payback on the capital investment. They principal markets for LMDS systems are large businesses, office buildings and multiple dwelling units. LMDS systems are also more vulnerable to interference from weather and other environmental condition because they operate at higher frequencies.

MMDS operates in the 2.5-2.7 GHz frequency band. MMDS was originally designed for the delivery of television broadcasts to areas not supported by cable or broadcast television networks. Regulatory changes in the United States and other countries have granted the right to use MMDS spectrum for two-way access, enabling MMDS spectrum holders to offer voice, data, Internet and video services over their networks. MMDS providers are focused on delivering wireless connectivity to the home user.

Spectrum to operate in licensed frequencies for MMDS and LMDS is controlled by national regulatory authorities such as the FCC in the United States and Industry Canada. The practice in Canada, the United States and in most countries is to sell spectrum licenses through an auction process to the highest bidder. As a result of the high prices paid for these licenses, operators who have spectrum licenses for LMDS or MMDS spectrum are

usually large and well capitalized. The high cost of acquiring a license in addition to deploying a wireless network, is a significant barrier to entry to most operators.

License-free spectrum which encompass the ISM bands in the 900 MHz and 2.4 GHz frequency range and 5 GHz U-NII band, are an attractive option for WISPs who want to obtain a rapid and cost-effective entry into most markets. In most countries, wireless products can be operated in the ISM bands without a license if the products do not exceed certain output power specifications. Radios operating in the ISM band utilize spread spectrum modulation, which makes them less susceptible to interference and jamming; however, because the bands are not licensed the band can become congested if too many WISPs attempt to implement services in the same region. The principal benefits of the ISM bands is that there is no cost to use the spectrum, and equipment designed for the license-free bands is generally less expensive than equipment designed for the licensed bands. Services as a result can be delivered at a lower cost to the end user.

License-free FWA systems have the following advantages:

- *Attractive business model* – FWA systems are scalable and can be deployed quickly with incremental capital investment. The majority of required capital investment is spent when a customer is set up, enabling the service provider to build the network as customers come online. As a result, return on investment is rapid and directly related to the number of customers.
- *Complementary to other technologies* – CLECs and network operators can use broadband wireless as a complementary option to xDSL, fiber or cable. Since fiber is expensive to deploy and cable and xDSL do not reach all businesses and homes, FWA is an effective solution to reach under-served business customers.
- *Bottleneck in the last mile* – although there have been significant improvements in network capacity, little has been done to improve the bandwidth that reaches the end-user. FWA provides an effective solution to alleviate this bottleneck.
- *Control over the network infrastructure* – a CLEC or an ISP who deploys a FWA system is not dependent on an ILEC or cable company, and as a result can control the quality of service delivered to their customers and at the same time maintain greater profit margins.
- *Rapid installation* – Once roof rights have been secured, FWA systems can be installed in days rather than months or years.
- *No stranded assets* – If a customer moves or is shifted to fiber, radio equipment can be re-deployed in another location.

This paper examines fixed wireless access technology that operates in the license-free Industrial, Scientific & Medical (ISM) bands operating in the 2400-2483.5 MHz frequencies and using spread spectrum technology. Spread spectrum technology is a modulation technique that spreads data transmissions across the entire available frequency band in a prearranged scheme. This type of modulation makes the signal highly resistant to noise, interference, and interception. Spread spectrum technology also permits many users to share a frequency band with minimal interference from other users. There are two types of spread spectrum modulation: Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS).

In the license-free bands, outdoor wireless bridges such as the WaveRider NCL series which utilize spread spectrum technology have been used by ISPs and other network operators to extend high-speed Internet access to their business customers. Most of these installations were used for point-to-point links for a wide variety of applications. Point-to-multipoint links became more common with the introduction of newer features and functionality. Systems developed with wireless bridges work well in small markets with a few customers, however, many ISPs discovered that the scalability and flexibility of these systems was limited. Lacking network and subscriber management capabilities, wireless bridges by themselves are insufficient for deploying a FWA particularly if there was a significant customer base and demand was growing significantly.

THE WAVERIDER SOLUTION

Recognizing the need for a scalable solution for network operators wanting to deploy a FWA system, WaveRider has developed the LMS (Last Mile Solution®) series of products. Operating in the 2.4 to 2.4835 GHz license free radio band, WaveRider's LMS2000 represents the worlds' first fully networked fixed wireless Internet access system. WaveRider's LMS platform is a fully managed Direct Sequence Spread Spectrum digital packet network. The LMS series wireless Internet network is aimed at providing wireless service providers such as cellular, paging, SMR, ESMR or PCS carriers and Internet service providers with a cost effective way of delivering high-speed wireless Internet access to organizations, small office/home office (SOHO) and SMB customers. By providing network operators with an alternative solution to wire-based Internet access, the LMS series substantially reduces the ongoing operating costs of Internet service provision. In addition to creating this new class of Wireless Internet Service Provider (WISP), the LMS series affords the benefits of higher levels of service and functionality to a WISP's subscriber base.

Deployment of an LMS series network offers existing and future WISPs a number of substantial business benefits. The LMS network architecture is based upon a combination of cellular and local multipoint distribution system (LMDS) topologies, where cellular type approaches are used for wide area coverage, and the LMDS approaches are used to provide high performance levels. This unique architecture of the LMS series permits

scalable network growth as market demand dictates, while at the same time providing a high degree of reliability and redundancy via overlapping service coverage areas and a distributed control/routing subsystem. This translates into low network start up costs, as initial network deployments can be limited to primary target markets and the network later expanded as demand increases.

As well as scalability, the LMS series enables the delivery of a portfolio of access services based on data speed and access priority. With this portfolio, WISPs will be able to offer services to the business, SOHO and consumer market segments that are tailored to each customer group's needs. With raw Internet access speeds ranging up to 11Mbps, the LMS series addresses the reality of today's market needs while ensuring tomorrow's requirements for speed are satisfied.

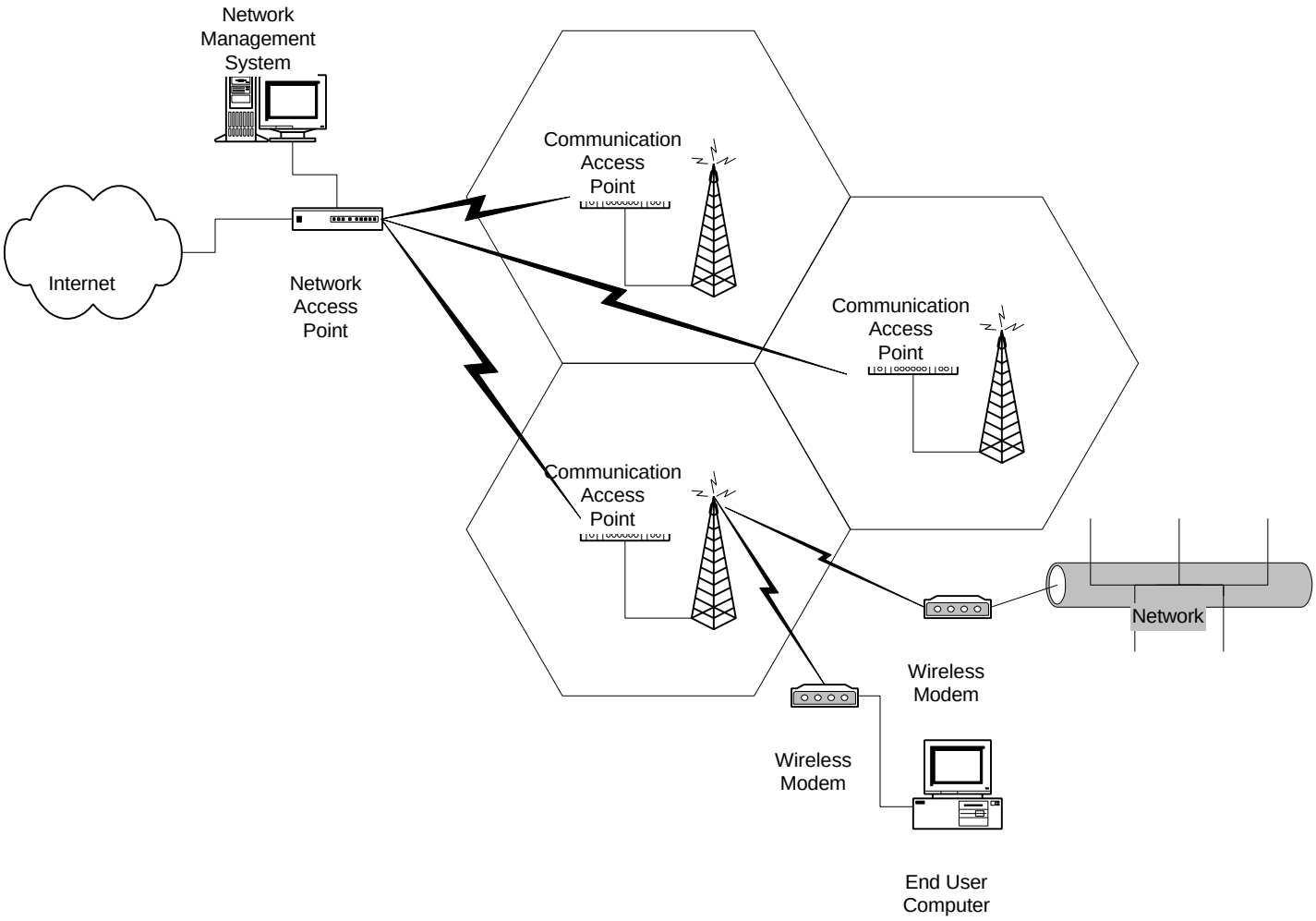
The LMS series network is capable of supporting thousands of customers. Similar to cellular telephone networks, radio frequencies are assigned in a fashion that permits the re-use of radio frequencies in other cell sites. This process allows for the deployment of small rural networks and large urban networks. In the future, the LMS system architecture will support the utilization of additional Industry, Science and Medical (ISM) band frequencies that will further increase overall system capacity. The initial LMS product portfolio is comprised of multiple product offerings, the first of which is the LMS2000. The LMS2000 is a point to multipoint 2.4 GHz network designed to provide organizations and businesses with high speed Internet and LAN connectivity. Using LMCS/LMDS network architectures and operating in both point to point and point to multipoint modes the LMS2000 will provide Internet and LAN connectivity at raw data speeds up to 11Mbps.

LMS2000 SYSTEM COMPONENTS

The basic building blocks for a LMS2000 system include the following:

- Network Access Point (NAP) – provides system access to the Internet and system management.
- Communications Access Point (CAP) – provides the “last mile” connectivity between the end-user modems and the Internet.
- Wireless Modem – connected to a LAN or directly to a PC, the wireless modem communicates with the CAP to connect to the Internet.

The network architecture of the LMS2000 system demonstrating the use of these components is illustrated in the following figure.



LMS2000 System Architecture

NAP Features and Functionality

The NAP provides the network operator with the necessary hardware and software to operate and maintain the system. The NAP provides the following services for the LMS2000 system:

- Subscriber management is implemented with RADIUS. RADIUS extensions will be implemented or supplied by the NAP contractor to support billing, feature and security aspects in the wireless environment. In large LMS2000 systems in which more than one NAP is deployed RADIUS provides the flexibility to support distributed or centralized subscriber management.
- Bandwidth management is utilized in order to prevent LMS2000 throughput requirements from adversely affecting other areas of the system and to provide service classes to specific end users.
- Operation Alarm and Maintenance (OAM) support resides on the NMS and is a required function of the NAP for proper commissioning and operation of the LMS2000. For the LMS2000 OAM refers to normal operation, alarming, maintenance and equipment management. SNMP v2.c is the enabling mechanism for OAM in the LMS2000 system. LMS2000 allows the WISP to modify operational parameters of the system. SNMP traps are used to provide alarm indications within the system. Optional automated call out may be used to notify system operators of mission critical alarms. Maintenance features of the LMS2000 NMS allow the operator to verify the operation of modules in the network and to support maintenance of system components.
- Network Security is provided through the use of optional firewall software at the NAP router.

CAP Features and Functionality

The CAP provides the following services:

- Wireless modem airlink
- Data connectivity between the NAP and wireless modems.
- Support for user authentication
- Data distribution to end users in the CAP serving area
- Enhanced Operation, Alarms and Maintenance

Wireless Modem Features and Functionality

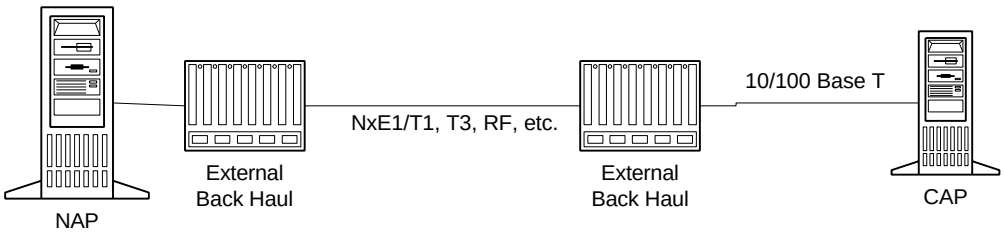
The wireless modem is designed to serve a wide variety of customers such as small and medium-sized businesses. The wireless modem is connected to an external antenna mounted on the roof or on the side of the building. Additional features include:

- Connectivity – 10/100BaseT with layer 3 routing
- User throughput – up to 7 Mbps.
- Static routing standard. RIP and OSPF available as options

Backhaul Requirements

Moving data between the CAP and NAP requires the deployment of network backhaul facilities.

The data backhaul connection at the CAP is 10/100 Base T. This may be directly connected to the NAP to or an



external backhaul device as shown above. A variety of backhaul options can be utilized including WaveRider's NCL wireless bridges, licensed microwave radios, T1/E1 lines or xDSL lines.

LMS2000 BUSINESS CASE

In advance of any deployment, a service operator needs to develop a business plan and model that can identify the capital expenditures and revenue potential of the planned system. WaveRider has developed financial models and tools that enable the service operator to assess potential return on investment. WaveRider can also provide assistance to the WISP in developing a business model in order to assist in optimizing costs and determining investment paybacks in order to raise investment capital or to secure financing.

The process of developing a business case is unique to each WISP. The information required to develop a strong business case includes:

- Target market identification and proposed coverage area
- Service definition and pricing
- System equipment requirements and specifications
- Network deployment schedule

Target Market Identification

Sizing the potential market is usually the first part of any planning exercise. Assessing the size of a market involves more than demographic analysis, there are several elements which need to be examined in order to obtain an accurate estimate. In looking at opportunities the SMB sector, the WISP should begin by obtaining statistical information on the number and types of SMB enterprises in the target area. These numbers provide a base level on the size of the target market. The next step is to identify the proportion of the target market which is likely to require high-speed Internet access. This is accomplished by examining the following issues:

- Existing and potential customer usage patterns, characteristics and requirements
- Availability (or lack) of alternative high-speed access services
- Level of competitor activity and competitive pricing factors
- Satisfaction with existing providers and access services

SMB customers depending on the nature of their business and telecommunications requirements are willing to pay a premium for high quality, reliable service, and have a need for high-speed data transmission. Although there may be existing high-speed services available to these customers, a wireless solution can be positioned as a cost-effective alternative.

The presence of competitors in the target market also needs to be evaluated. The WISP needs to understand to understand the position of all competitors in terms of their service offerings and pricing. A basic SWOT (strengths, weaknesses, opportunities and threats) analysis can provide a good snapshot on the nature of the competition in a particular market. A competitor profile can be created by looking at the following factors.

Strengths and Weaknesses	Opportunities and Threats
• Financial resources	• Service offerings
• Technology deployment	• Pricing
• Customer service	• Market position
• Management	• Customer segment profile
• Marketing	• Geographic coverage
• Strategic alliances	• Customer satisfaction

By evaluating the competitive landscape, a WISP can obtain a good indication of the risks and rewards of the proposed venture. This assessment will enable the WISP establish some assumptions on how a new wireless service will be received by their existing customer base and how it can attract customers from a competitor. In addition, a profile will provide a good indication as to how competitors will react to the introduction of a new service in the market.

Service Definition and Pricing

Utilizing the market information obtained on the market demand and competitive landscape, the WISP can then identify the types of services that offer the best growth and profit potential. The LMS2000 gives the WISP control over the “last mile” to their customers. Unlike cable modem or xDSL service, where the infrastructure is owned and maintained by a telco or cable company and the service provider only has access rights, the LMS2000 is owned and maintained by the WISP. This additional control over the infrastructure enables the WISP to tailor services for their target market, ensure that the quality of service is maintained to achieve high levels of customer satisfaction, and react quickly to changes in customer requirements.

The other advantages of the LMS2000 are its network and subscriber management capabilities. The WISP can deliver wireless access to targeted customers at speeds that match their requirements. Unlike a “one speed fits all approach” offered by most systems, the LMS2000 enables the WISP to maximize the use of system resources and profit margins, and at the same time maximize value to their customers. With the ability to offer different service levels, the WISP can approach different customer segments and ultimately establish different revenue streams.

Once the service levels have been defined and the pricing established, the WISP can then develop a revenue model based on the target market projections. A typical revenue model can include the following elements as outlined in the example below.

Business Market	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Market Size	2,000	2,100	2,200	2,300	2,400
Uptake Rate	30%	35%	40%	45%	50%
Market Share	15%	20%	25%	30%	35%
Projected Clients	**90**	**147**	**220**	**311**	**420**

Service Definition	**128 Kbps**	**256 Kbps**	**384 Kbps**	**512 Kbps**	**768 Kbps**	**1.5 Mbps**
Subscribers	35%	20%	15%	10%	10%	10%
Monthly Charge	$ 75	$ 140	$ 190	$ 300	$ 450	$ 600

Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
128 Kbps	$ 28,350	$ 46,305	$ 69,300	$ 97,808	$ 132,300
256 Kbps	$ 30,240	$ 49,392	$ 73,920	$ 104,328	$ 141,120
384 Kbps	$ 30,780	$ 50,274	$ 75,240	$ 106,191	$ 143,640
512 Kbps	$ 32,400	$ 52,920	$ 79,200	$ 111,780	$ 151,200
768 Kbps	$ 48,600	$ 79,380	$ 118,800	$ 167,670	$ 226,800
1.5 Mbps	$ 64,800	$ 105,840	$ 158,400	$ 223,560	$ 302,400
Total Revenue	**$ 235,170**	**$ 384,111**	**$ 574,860**	**$ 811,337**	**$ 1,097,460**

System Requirements and Specifications

Although the system requirements and specifications determine the cost elements of the business case, there are several elements which have to be defined before the final system specifications can be prepared. The total cost of a system depends on a number of different factors.

- The portfolio of defined services will have an impact on the core network architecture.
- Estimated market demand will determine system capacity requirements.
- Redundancy requirements necessary to ensure system availability in the event of equipment failure.
- Rooftop and tower acquisition and rental costs for CAP and EUM antennas.
- Installation costs for antennas, end-user and network system equipment.
- Engineering expenditures for cell planning and network design.
- Backhaul requirements to link remote CAP sites to the NAP.
- Customer technical support and system maintenance costs.
- Sales and marketing expenditures to support service introduction and rollout.
- Financing costs for equipment and other capital expenditures.

For the operator who is not experienced in providing wireless services there are other expenditures which should be anticipated. These include staff training or the acquisition of staff with RF engineering backgrounds and experience.

The objective of the WISP is to deploy services in markets where the quickest payback and highest return on investment can be achieved. The decision to provide wireless services to a particular customer simply requires an assessment of the revenue potential for that customer versus the cost of providing those services. In order to ensure that other costs are covered and that it is a profitable installation, an investment in a customer deployment should be paid back within 12 to 18 months.

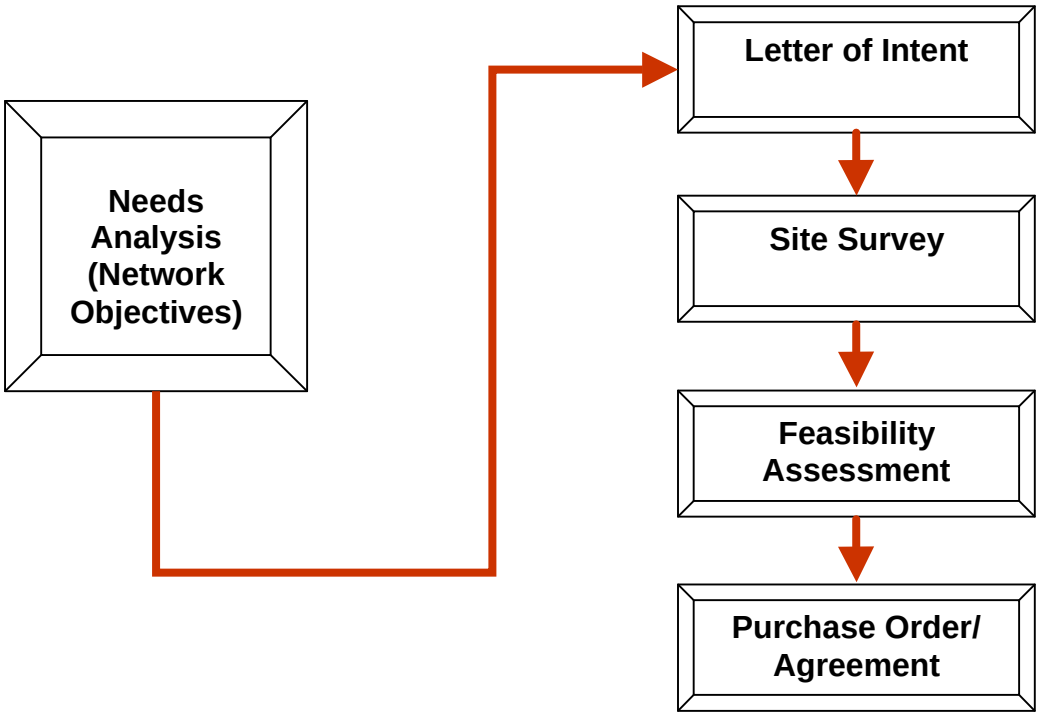
In assessing the payback potential for a target market, the system operator needs to identify the revenue potential based on the number of customers, service and revenue mixes and penetration rates. The calculated revenue potential should then be compared with deployment costs to determine the potential return or payback on investment. The greatest yield of high profitability sites can then be identified. Cell sites can then be designed and deployed to achieve the highest profitability.

In advance of any system deployment there is much work that has to be performed. WaveRider has developed business modeling tools to assist the operator in network planning and deployment. Coupled with WaveRider's technical expertise and assistance, the network operator has can be assured that the necessary groundwork will be laid to ensure a successful system deployment.

LMS2000 SYSTEM IMPLEMENTATION

WaveRider has devised a 3-Stage Implementation Process to ensure that systems can be deployed in the most-effective manner by optimizing available resources and reducing time to market. Prior to the Implementation Process, WaveRider works closely with service providers to evaluate proposed system deployments by preparing business case models and preliminary network designs. By undertaking a vigorous needs analysis and outlining the objectives of the proposed network, both WaveRider and the service provider can obtain a preliminary assessment the feasibility of a network before proceeding with the Stage 1 of the implementation.

Stage 1

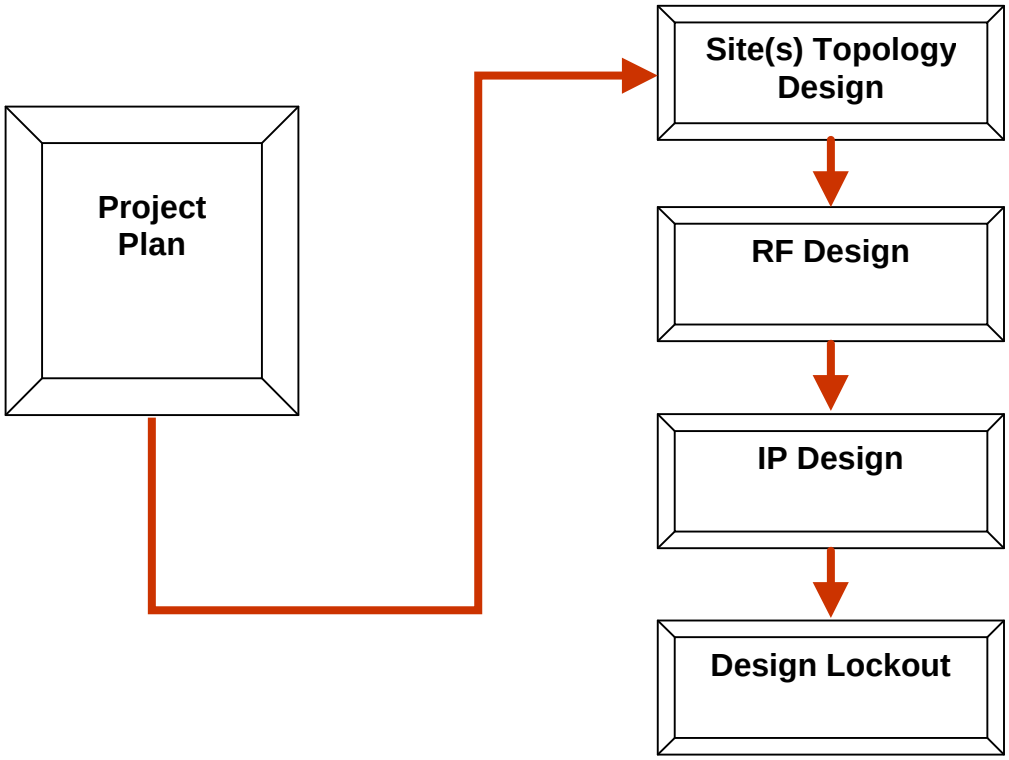


The first stage begins with a Letter of Intent (LOI). The LOI sets the stage for a more detailed assessment of the proposed network. Following the LOI, a WaveRider engineering team will prepare a site survey. This survey assesses existing IP resources to determine if they are adequate to support the proposed wireless network. A RF survey is then commissioned to check radio propagation characteristics of the area in which the network will be deployed. Concurrent with these studies, the service provider will investigate site acquisition for NAPs, CAPs and other system network infrastructure. Data from the IP and RF surveys and the service provider's investigations is then used to complete a Feasibility Assessment which will outlines system requirements and options, including:

- IP capabilities and upgrade recommendations
- RF spectrum occupancy and problem areas
- Construction requirements
- Backhaul and infrastructure requirements
- Estimates on capital costs and other implementation expenses

Using data from these studies, WaveRider works with the service provider to review and modify the business case model to complete an assessment of the feasibility of the proposed network. If the assessment is positive an agreement is prepared outlining a description of the system, the pricing structure and an initial deployment schedule. At the completion of this agreement, the service provider will issue a purchase order.

Stage 2

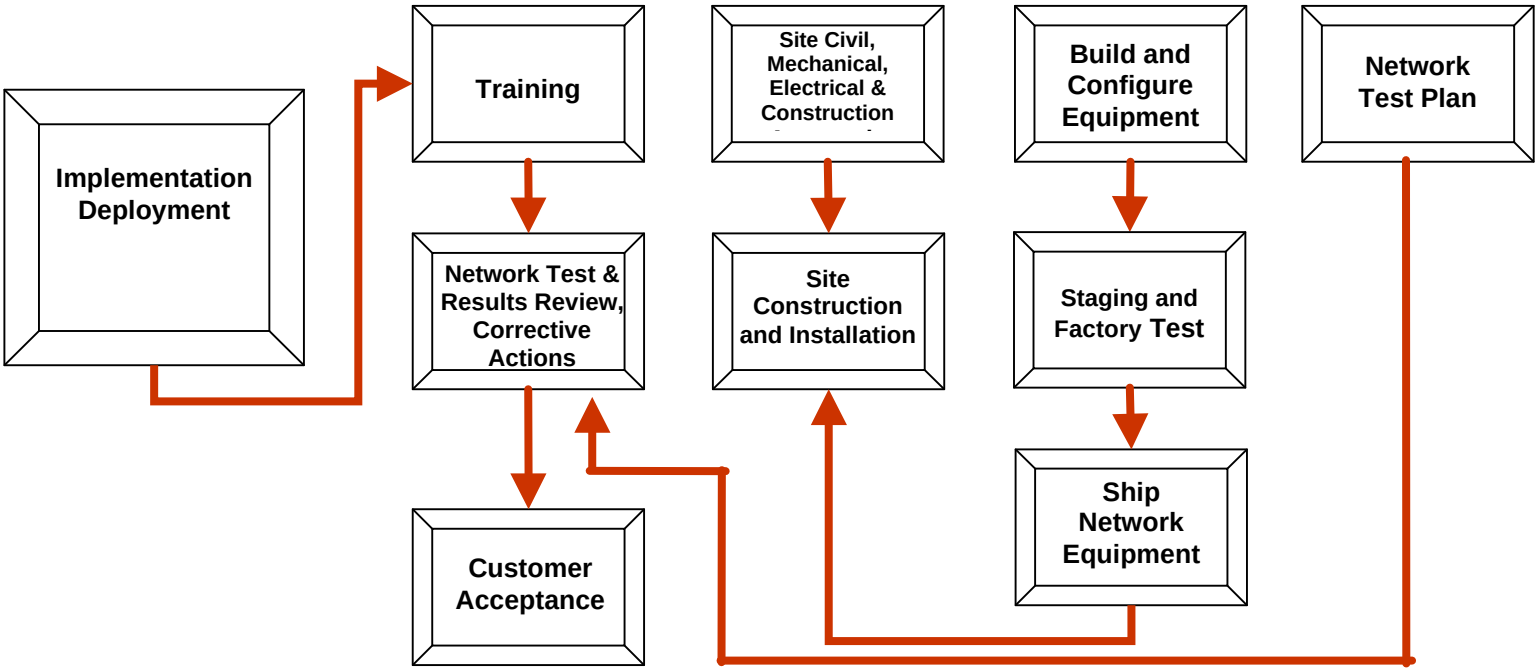


The system project plan is then developed after the receipt of a Purchase Order from the service operator. WaveRider's Customer Support Group working with installation and systems integration partners complete the project definitions and specifications. The activities in this stage include:

- Site requirement specifications verified and finalized
- RF Design developed
- System Design completed
- Construction schedule proposed

The completion of these steps is needed to lockdown the design for the final network leading to the next stage which covers the actual implementation and deployment of the system.

Stage 3



The final or implementation stage has a number of concurrent activities. At this stage the customer receives intensive training on the LMS system. The training covers all aspects of system operation and configuration. Once the customer has received training, WaveRider will work with the customer to develop a Network Test Plan appropriate for the customer's network configuration.

Construction and installation of the system begins at this stage once all the civil, mechanical and electrical approvals have been obtained. Equipment for the NAP, CAP and initial customer installations is delivered to the customer. Following the completion of the installation, he system undergoes testing and results are reviewed in accordance with the baseline parameters established under the Network Test Plan. Corrective actions are taken if required following the test. Customer acceptance of the system is then obtained once the system has met the criteria as outlined in the Network Test Plan.

CONCLUSION

This brief White Paper has covered just some of the issues and benefits in deploying the LMS2000 FWA system for the business market. The market opportunities are significant, and the LMS2000 is a turnkey solution that is available today. The LMS2000 provides a cost-effective broadband solution characterized by ease of installation and maintenance, rapid deployment, flexibility and scalability. It can be used to complement existing services or as a standalone solution for new market opportunities where the options for broadband access are limited or prohibitively expensive.

For additional information on the LMS2000 visit WaveRider at ***www.waverider.com***, or request additional information via email: ***info@waverider.com***.